SOIL QUALITY ASSESSMENT THROUGH INTEGRATION OF DRONE BASED REMOTE SENSING AND AI IN ABU DHABI

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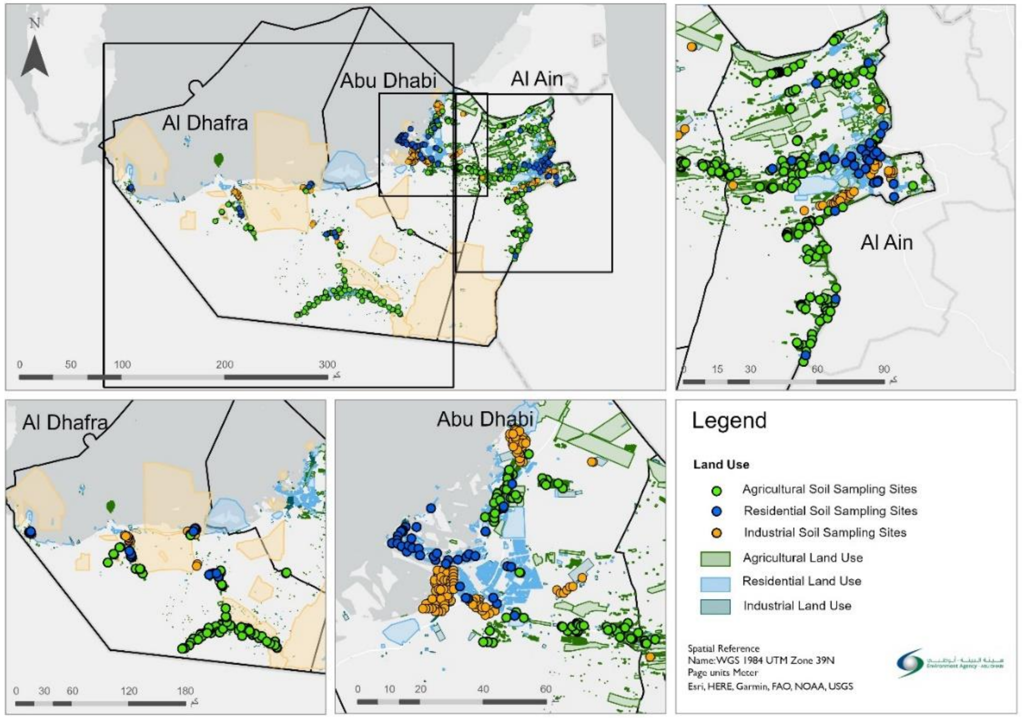
ESA Symposium on Earth Observation for Soil Protection and Restoration

SOIL QUALITY MONITORING PROGRAM

Limitations Of Conventional Methods Of Monitoring



- Laboure intensive
- Representation
- Coverage
- Frequency

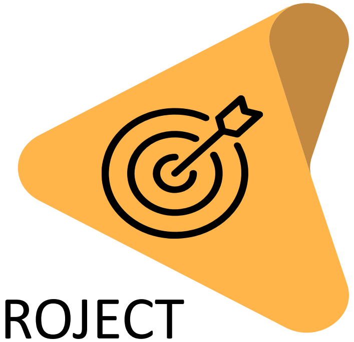
- ↑ COST
- ↑ TIME
- ↓ACCURACY

DRONES & AI FOR THE CONSERVATION OF THE ENVIRONMENT AND SOIL QUALITY MONITORING

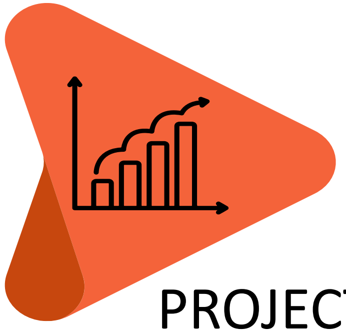
Augmenting current monitoring

Machine Learning (ML)
Artificial Intelligence (AI)

BINARY CLASSIFICATION



PROJECT AIMS



PROJECT OUTCOMES

Greater efficiency and higher accuracy

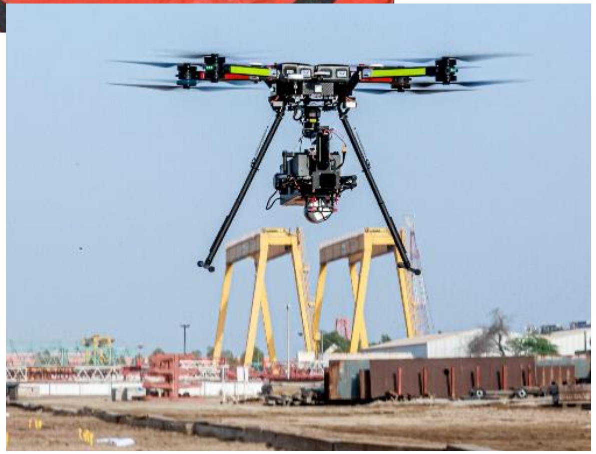
End-to-end product

Improved mitigation and remediation

Soil and contaminant spectral characterization in Lab environment

Soil and contaminant spectral characterization in soil archive samples

Soil and contaminant spectral characterization in real field



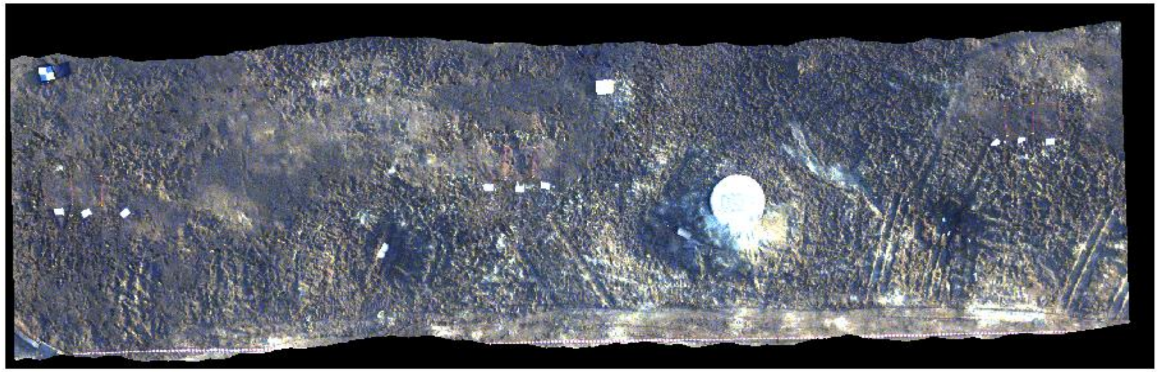
METHODOLOGY

- Hyperspectral Mjolnir (VNIR+SWIR) hyperspectral cameras in common housing that co-registered pixels in the VNIR and SWIR spectral range, 400-2500 nm in 490 bands
- 3D LiDAR with 360° surround view to capture real-time 3D LiDAR data

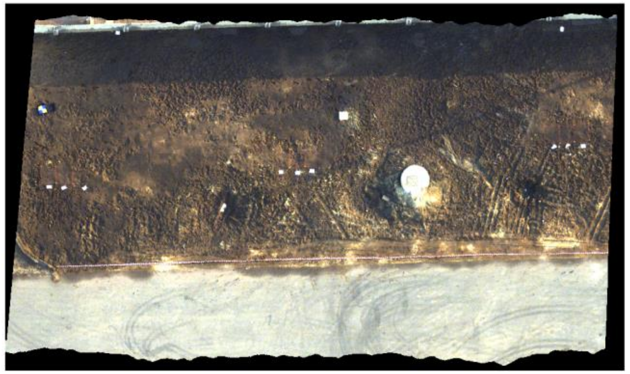
165 points
328 soil samples
- 0-5 cm
- 5-10 cm

Collecting Soil Samples to Calibrate the Results of Spectral Images

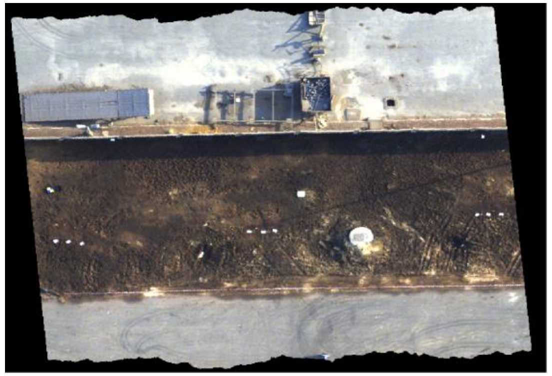
30 m



60 m



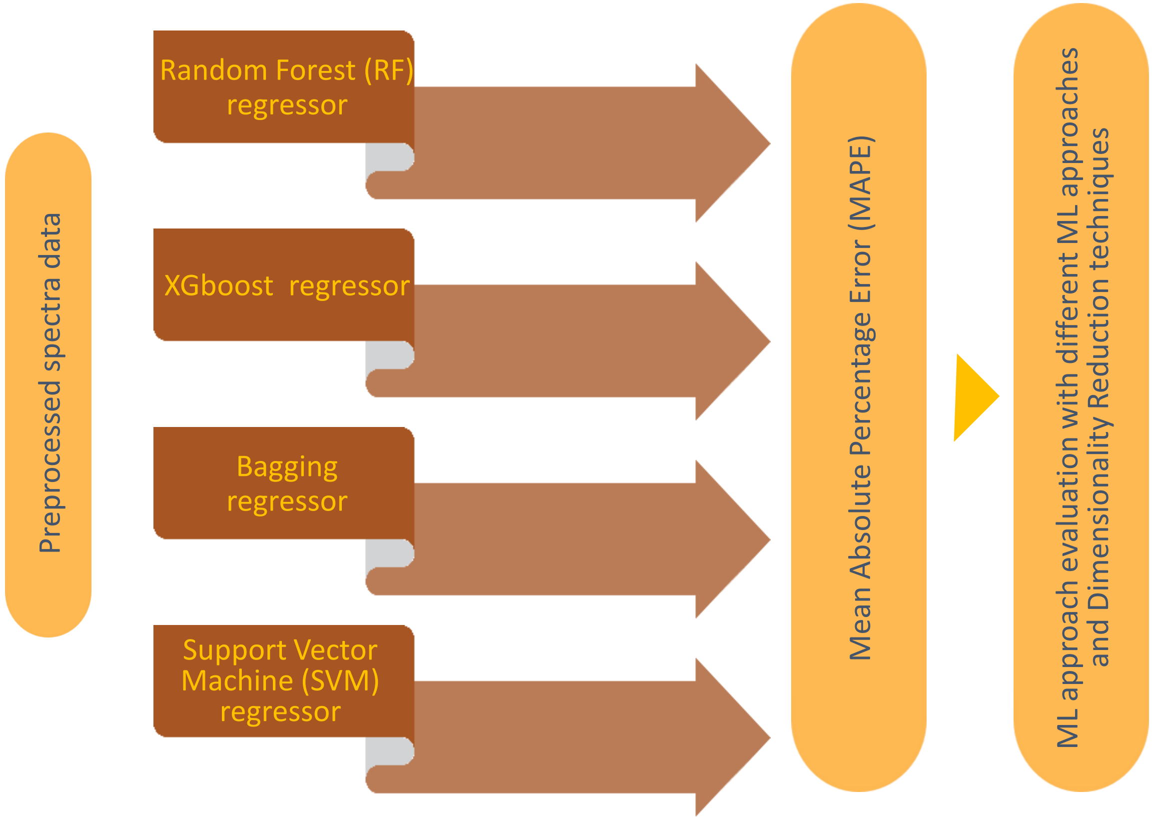
90 m



DIFFERENT AI MODELS USED

- Random Forest (RF):
- XGBoost:
- Bagging Regressor:
- Support Vector Machine (SVM):
- Dimensionality Reduction Techniques:
- Mean Absolute Percentage Error (MAPE):
- Preprocessed Spectra Data

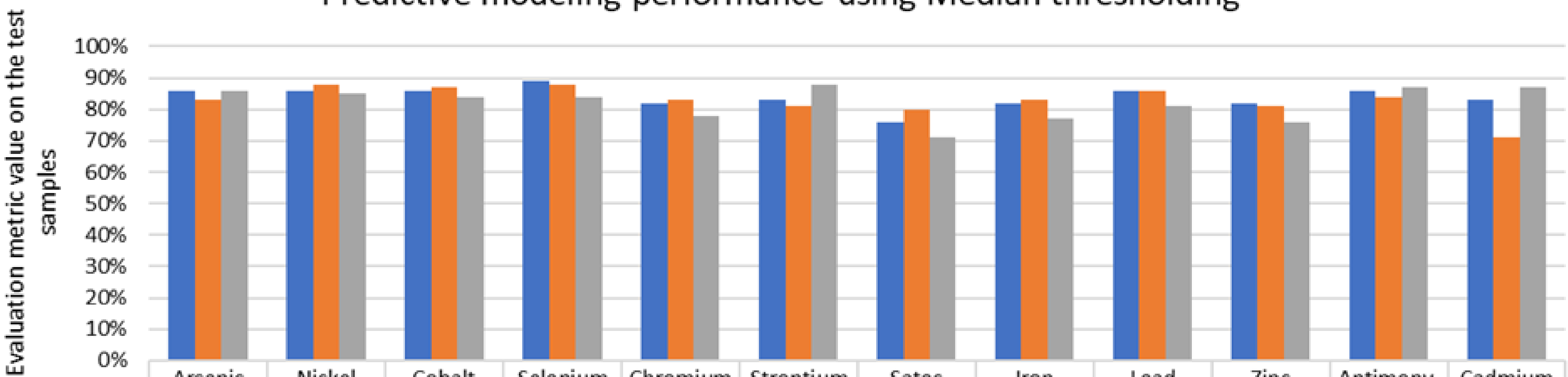
Our comprehensive approach involves evaluating multiple ML approaches and dimensionality reduction techniques to identify the most effective strategy for predicting heavy metal contaminant concentrations.



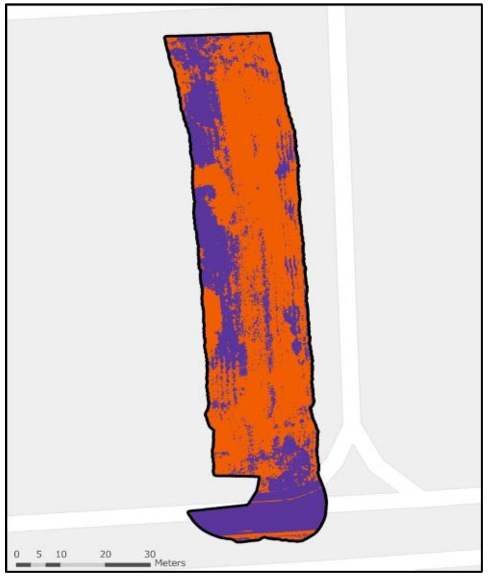
PRELIMINARY RESULTS OF BINARY CLASSIFICATION OF HEAVY METALS

Random Forest (RF)

Predictive modeling performance using Median thresholding



	Arsenic	Nickel	Cobalt	Selenium	Chromium	Strontium	Satec	Iron	Lead	Zinc	Antimony	Cadmium
Accuracy	86%	86%	86%	89%	82%	83%	76%	82%	86%	82%	86%	83%
Precision	83%	88%	87%	88%	83%	81%	80%	83%	86%	81%	84%	71%
Recall	86%	85%	84%	84%	78%	88%	71%	77%	81%	76%	87%	87%



CONCLUSIONS

- Low concentrations of contaminants lead to unbalanced datasets

- Although the soils are quite homogeneous, debris can introduce noise in the signal

- The influence of physicochemical properties (e.g. texture, structure, ECe, pH and color) could generate interferences

- Binary maps generated using Remote Sensing can help to detect and react timely to contaminated areas for remediation

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